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REMOTE STORAGE

MAGNETIC PHENOMENA AROUND DEEP BORINGS.

BY A. C. LANE, STATE GEOLOGIST.

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In an early paper by Prof. Alexander Winchell he calls attention to magnetic phenomena around certain springs in the State, but without specifying precisely what these phenomena were. It is also noteworthy that a large number of the springs or rather artesian wells, that have been exploited as mineral waters, have "magnetic" in their name* or like the St. Louis spring make reference in their circulars to their magnetic powers as of great value. In the course of my studies on the water supply of Michigan, and in the examination of other borings of various kinds, which is part of my regular business, it became a matter of some interest to know just what these magnetic phenomena were. So far as I could find out they were of two kinds. All the wells in question are drilled wells in iron casing, and even when this casing was said to be wrought or soft iron it had a considerable attraction. It would for instance hold out nails, and the pull upon a wrench could very readily be felt. Sometimes too, it was noticed that the blade of a knife immersed in the water also became magnetic. Of this last statement I may remark that while it is very easy for knife blades to have become magnetic without the owner's knowledge yet there is no reason to doubt that in some cases knife blades did really become magnetic. However, I do not know of any case where the knife blade became magnetic except as it was held in the water as it flowed from the casing, and hence close to the latter. Now any knife blade being steel if it is held close to a magnet will soon become permanently magnetized itself, so that the two phenomena reduce themselves to one, mainly the magnetism of the casing. As to any well defined magnetic effects of the waters of a medical nature I am not qualified to judge, not being a physician, nor have I had them stated to me in any tangible state. Now in regard to the casing, we must remember that the earth as a whole is a magnet and electro-magnetic currents are continually flowing in it, and that any iron rod or tube lying in a magnetic field and cutting the lines of force will itself be magnetized, just as a soft iron nail touching or close to a magnet will itself become attractive and be able to draw a smaller nail. Applying this to the case of these deep wells we have continuous lines of iron pipes, of wrought iron or steel (and sometimes pipe that is sold for wrought iron is really steel), which may vary in length from a hundred feet to two or three thousand or more and it is not surprising that they should be magnetic as they cut a good many lines of force of the great earth magnet. These lines are represented in a horizontal direction by the compass and in a vertical plane by the dip needle. If this explanation of the magnetism is correct, then all strings of casing should prove to be more or less magnetic. Such indeed I have found to be the case very often to the considerable surprise of the owners thereof, though well drillers tell me

* Such as Midland Magnetic, Grand Rapids Magnetic, Riverside Magnetic at Detroit, and Magnetic Springs at Leslie, Lansing, Fruitport and Hubbardston, the analyses of which are given in Water Supply Paper No. 31 of the U. S. Geological Survey.

that they know this to be the rule. This magnetic force is sometimes very considerable. It will often hold out the largest size of spike, and I believe in the case of the well over five thousand feet deep, tested by Prof. William Hallock of Columbia University, it could hold a wrench. I have found that in lowering a thermometer down these wells the steel tape clung to the sides so that it made a material difference in the energy required to handle it. It was just about as much as a man could do to start 2,600 feet of steel tape from the Grayling well, although the weight of the tape itself would not be over 25 pounds. Again in measuring the depth of a well recently sunk at Cheboygan, 2,700 feet deep or more, Mr. Rust the driller, informed me that the magnetic drag on the tape was such that it was also impossible to tell when the 20 pound weight was at the bottom. At the same time it seems to me that the magnetism is not directly proportional to the depth of the hole alone, although the larger and deeper holes are of course in a general way more magnetic, and I should think there might be interesting opportunity for some student of geophysics to make some magnetic observations of considerable interest. The university of Michigan has for instance put down recently a well some 1,300 feet deep, which at one time, if not at present, was cased over a thousand feet. It would seem that here might be a good chance for careful experiment. I should be very glad to have any suggestions from students of physics as to how observations upon these phenomena could be made more definite and instructive. Before closing I would like to mention another phenomenon though it does not occur in a deep boring but in a deep shaft. The Tamarack mine has recently sunk a shaft (No. 5), which goes vertically downward some 4,666 feet before it encounters the lode which the mine is working. In preparing to connect this with the old workings of the mine two plumb bobs or pendulums were let down the shaft 4,250 feet, and whereas they were 17.58, or at another time 16.33, feet apart at the top, they were found to be 17.65 respectively 16.42 feet apart at the bottom. In No. 2 shaft the divergence was from 12.6 feet at the top to 12.7 feet at the bottom. This divergence was unexpected, but Prof. W. Hallock of Columbia who has investigated the matter, concludes that it is a phenomenon of a character similar to those we have described that the long wires in the magnetic field of the earth were magnetized, so that the similar poles repelled each other as they always do. He adds, "I may say that, as far as the magnetizing influence of the earth upon the casings is concerned, it would matter but little whether the pipes were really wrought iron or steel, because, inasmuch as they remain in the magnetic field, they would of course remain magnetized, even if they were soft wrought iron.

"A factor which probably influences the strength of the magnetism of these casings is the number of strings that may be put into any particular well. In the well at Wheeling there were, I believe four strings, the longest one being something over 1,500 feet. In that well it proved impossible to sink a steel tape through the casing, even with a 50 pound weight attached to the lower end of it. In my temperature observations a steel wire was used which of course adhered to the walls of the well but little."

Farther investigation at the Tamarack Mine by President McNair showed that the phenomenon there was mainly due to the draft of air.

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